

REMARKS

Claims 37-72 are pending and at issue. The office action has allowed claims 52-60 and objected to claims 38, 41, 43-48, 51, and 62-70 as being dependent upon a rejected base claim but otherwise reciting allowable subject matter. The office action has also confirmed that claims 71 and 72, which are in multiple dependent form, recite, at least in part, allowable subject matter. The remaining claims stand rejected under a single prior art rejection, an anticipation rejection based on *Murakami* (U.S. Patent No. 6,522,716) (“the ‘716 patent”).

The applicant appreciates the examiner’s attention to this case and the confirmations of allowability and patentability of numerous claims. The rejections of the remaining claims have been carefully considered and are respectfully traversed in light of the fact that the ‘716 patent is not prior art to these claims.

AMENDMENTS TO THE SPECIFICATION

The specification has been amended to add the issued patent numbers for the priority applications.

AMENDMENTS TO THE CLAIMS

The applicant has amended various claims above, including allowed claims, to clarify the reference to “a physical mirror surface” in those claims. Specifically, this term has been replaced with the term “a surface.” These amendments are not made for patentability purposes, but rather to transition the language of the claims from referencing a “physical mirror surface,” which is that part of the mirror surface onto which bundles of light impinge, to referencing, more generally, a “surface” of the mirror. The amended language, which often appears in claims along with a reference to a vertex, coincides with the description of the vertex in the specification, where a vertex is described as the “intersection point of a surface of a mirror with the principal axis (PA).” Page 3, lines 22-29 (Emphasis Added). No new matter has been added. Furthermore, the applicant respectfully submits that the status of the allowed claims and the objected to claims should not change based on the amendments above.

REJECTIONS UNDER 35 U.S.C. § 102(B)

Claims 37, 39, 42, 49, 50 and 61 stand rejected under 35 U.S.C. § 102(b) as anticipated by the '716 patent. The '716 patent, which issued on February 18, 2003, was originally filed as U.S. Application Serial No. 09/684,873 on **October 6, 2000**. This is the earliest priority date available for the '716 patent under 35 U.S.C. § 102.

The present application was originally filed on June 25, 2003 as a continuation of U.S. Application Serial No. 10/004,674, filed on December 3, 2001, which is a continuation-in-part of U.S. Application Serial No. 09/503,640 (the "'640 application"), which was filed on February 14, 2000. That is, the present application claims priority to an earliest United States filing date of **February 14, 2000**, which is before the priority date for the '716 patent, October 6, 2000. To demonstrate that the currently claimed subject matter is described and fully supported under 35 U.S.C. § 112 within the '640 application, the applicant cites below relevant portions of U.S. Patent No. 6,353,470 (the "'470 patent"), the patent that issued from the '640 application. The citations are provided by way of example and should not be interpreted as necessarily being exhaustive.

1. Claim 37

Claim 37 recites:

37. A projection objective with an object plane and an image plane and a light path for a bundle of light rays from the object plane to the image plane, the projection objective comprising:

at least six mirrors, each mirror having a surface and a vertex at the surface, wherein the distance between the vertexes of the surfaces of adjacent mirrors is chosen such that the at least six mirrors each have sufficient mirror thickness and stability to prevent surface deformations due to high layer tensions.

The present application provides support for the claimed subject matter in the first column below, while the support from the '470 patent is provided in the second column:

Present Application
(page 13, lines 20-25)

Furthermore, in the embodiments of FIGS. 2 and 4 to 6, the physical distance between the mirrors S3 and S6 is chosen so that mirrors of sufficient thickness can be used. Thicker mirrors have sufficient strength and stability properties that can withstand the high layer tensions described above. In these systems, the following relationship is preferred:

$0.3 (\text{used diameter } S3 + \text{used diameter } S6) < S3S6.$ (Emphasis added).

The "FIGS. 1 and 3 to 5" referenced in the '470 patent are the same as the "FIGS. 2 and 4 to 6" referenced in the present application.

As shown, both descriptions are nearly identical and both reference the desirability to have mirrors with sufficient mirror thickness and stability to withstand high layer tensions and thus prevent surface deformations. Accordingly, the applicant submits that the recited subject matter is supported in the '470 patent and thus not anticipated by the later-filed '716 patent. The rejection based on the '716 patent is traversed and reconsideration respectfully requested.

2. Claim 39

Claim 39 depends from claim 37 and, therefore, necessarily includes the subject matter of claim 37, which the applicant has noted above is not anticipated by the '716 patent. The applicant respectfully submits that for the same reasons outlined above, claim 39 is also not anticipated by the prior art, and the rejection of claim 39 should be removed. Additionally, the rejection of claim 39 is traversed because the subject matter of claim 39 derives support from the original '470 patent.

Claim 39 recites:

39. The projection objective of claim 37, wherein the mirror thicknesses of the at least six mirrors are sufficient to prevent surface deformations in edge regions of the at least six mirrors.

'470 Patent
(col. 7, ll. 11-18)

Furthermore, in the embodiments of FIGS. 1 and 3 to 5, the distance between the mirrors S3 and S6 is chosen to be of such a magnitude that mirrors of sufficient thickness can be used, thicker mirrors having strength, stability properties that can withstand the high layer tensions described above. In these systems, the following relationship is preferred:

$0.3(\text{used diameter } S3 + \text{used diameter } S6) < S3S6.$
(Emphasis added).

Relevant portions of both the present application and the '470 patent recognizing that mirror thicknesses should be set to prevent surface deformations in the edges of the mirrors are provided below. As can be seen, the two descriptions are nearly identical.

Present Application

(page 10, line 27 – page 11, line 9)

Such a physical distance guarantees a sufficiently free working distance A, and allows the use of optical components compatible for use with wavelengths < 100 nm, and preferably wavelengths of 11 to 13 nm. Optical components in this range include, for example, Mo/Si or Mo/Be multilayer systems, where the typical multilayer systems for $\lambda = 13$ nm is Mo/Si layer pairs and for $\lambda = 11$ nm, is Mo/Be systems, both of approximately 70 layer pairs. Reflectivities attainable in such systems are approximately 70%. In the multilayer layer systems, layer stresses of above 350 MPa may occur. Stresses of such values may induce surface deformation, especially in the edge regions of the mirror. (Emphasis Added)

The '470 Patent

(col. 5, ll. 56-67)

Such a distance guarantees a sufficiently free working distance, one greater than 0, and allows the use of optical components compatible for use with wavelengths < 100 nm, and preferably wavelengths of 11 to 13 nm. Optical components in this range include, for example, Mo/Si or Mo/Be multilayer systems, where the typical multilayer systems for $\lambda = 13$ nm is Mo/Si layer pairs and for $\lambda = 11$ nm, is Mo/Be systems, both of approximately 70 layer pairs. Reflectivities attainable in such systems are approximately 70%. In the multilayer layer systems, layer stresses of above 350 MPa may occur. Stresses of such values may induce surface deformation, especially in the edge regions of the mirror. (Emphasis Added)

The highlighted language in both quotations recognizes that layer stresses, or layer tensions, above 350 MPa may result in surface deformations, especially in the edge regions of the mirror. Both descriptions recognize the problematic nature of certain layer stresses, so that such layer stresses may be avoided in certain example devices in the application. In fact, both the present application and the '470 patent describe and illustrate (including via numerous data tables) identical six mirror systems that avoid the detrimental surface deformations of the prior art, including edge region deformations.

In short, the applicant submits that the subject matter of claim 39 is supported in the '470 patent and thus not anticipated by the later filed '716 patent. The rejection based on the '716 patent is traversed and reconsideration respectfully requested.

3. Claim 42

Claim 42 recites:

42. (Currently amended) A projection objective with an object plane and an image plane and a light path for a bundle of light rays from the object plane to the image plane, the projection objective comprising:

at least six mirrors, a first mirror (S1), a second mirror (S2), a third mirror (S3), a fourth mirror (S4), a fifth mirror (S5) and a sixth mirror (S6) in the light path from the object plane to the image plane, wherein each of the at least six mirrors has a surface and wherein the distance between a vertex of the third mirror (S3) and a vertex of the sixth mirror (S6) is chosen such that the at least six mirrors have sufficient thickness and stability properties to prevent surface deformations due to high layer tensions.

As noted above in the discussion of claim 37, the '470 patent supports the recited subject matter, at least, in the following recitation:

Furthermore, in the embodiments of FIGS. 1 and 3 to 5, the distance between the mirrors S3 and S6 is chosen to be of such a magnitude that mirrors of sufficient thickness can be used, thicker mirrors having strength, stability properties that can withstand the high layer tensions described above. In these systems, the following relationship is preferred:

$0.3(\text{used diameter S3} + \text{used diameter S6}) < S3S6.$

'470 patent, col. 7, ll. 11-18.

Accordingly, the applicant submits that the subject matter of claim 42 is supported in the '470 patent and thus not anticipated by the later '716 patent. The rejection based on the '716 patent is traversed and reconsideration respectfully requested.

4. Claims 49 and 50

Claims 49 and 50 depend from claim 42, and because of their dependencies, necessarily include the subject matter thereof, which subject matter is not anticipated by the '716 patent. As such, the applicant respectfully submits that at least for the reasons outlined above, claims 49 and 50 are also not anticipated and their rejections should be removed. Further still, the rejections of these claims are traversed because each recites subject matter supported from the '470 patent.

Claims 49 and 50 recite:

49. (Currently amended) The projection objective of claim 42, wherein all surfaces are aspherical.

50. (Currently amended) The projection objective of claim 42, wherein at most five surfaces are aspherical.

The '470 patent provides support in at least the following descriptions:

Claim 49

(Citations to '470 Patent)

In order to be able to make the necessary corrections of the imaging errors in the six-mirror systems, in a preferred embodiment, all six mirrors are designed to be aspherical. Col. 4, ll. 7-9.

All mirrors S1-S6 of FIG. 1 are designed to be aspherical. Col. 6, l. 38.

A projection objective...wherein all mirrors are aspherical. Issued claim 17, depending from claims 1 to 4.

Claim 50

(Citations to '470 Patent)

In order to be able to make the necessary corrections of the imaging errors in the six-mirror systems, in a preferred embodiment, all six mirrors are designed to be aspherical. However, an alternative embodiment whereby at most five mirrors are aspherical thus simplifying the manufacturing process can be achieved [sic]. Col. 4, ll. 7-12.

A projection objective...wherein at most five mirrors are aspherical. Issued claim 18, depending from claims 1 to 4.

Accordingly, the applicant submits that the subject matters of claim 49 and claim 50 are supported in the '470 patent and thus not anticipated by the later-filed '716 patent. The rejections based on the '716 patent are traversed and reconsideration respectfully requested.

5. Claim 61

Claim 61 recites:

61. (Currently amended) A projection objective with an object plane and an image plane and a light path for a bundle of light rays from the object plane to the image plane, the projection objective comprising:

at least six mirrors, a first mirror (S1), a second mirror (S2), a third mirror (S3), a forth mirror (S4), a fifth mirror (S5) and a sixth mirror (S6) in the light path from the object plane to the image plane, wherein a distance between a vertex of the fifth mirror (S5) and the image plane is chosen such that at least the fifth mirror (S5) has a sufficient thickness and stability to prevent surface deformations due to high layer tensions.

Both the present application and the '470 patent describe an advantageous distance between the fifth mirror (S5) and the image plane (4) to eliminate stability problems due to high layer tensions. The '470 patent, for example, describes problems associated with the prior art U.S. Pat. No. 5,686,728 disclosure, problems that are avoided by the techniques described in the '470 patent. For example, the '470 describes:

FIG. 2 shows an arrangement of a projection objective for microlithography with a wavelength of $\lambda < 100$ nm according to U.S. Pat. No. 5,686,728. Components substantially similar to those of FIG. 1 are provided with the same reference numbers. As is clear, the distance between the mirror next to the wafer S5 and the wafer is significantly smaller than the diameter of the mirror, lying mainly in the range of approximately 20 mm. This leads to strength, stability problems for the optics in the EUV region because of the extreme tensions in the layers. Furthermore, the system has very high asphericities of ± 50 μ m and a maximum angle of incidence of 38° . From a manufacturing and coating technology point of view, such asphericities and angles of incidence are incompatible for use in the EUV region. Col. 7, l. 58 – Col. 8, l. 4.

To avoid the high layer tensions of the U.S. Pat. No. 5,686,728 device, the '470 patent describes example properties for the fifth mirror (S5), including:

Furthermore, the distance between the mirror next to the wafer, i.e., the 5th mirror S5 in the present embodiment, and the plane of the wafer 4 is greater than the used diameter of mirror S5. In other words, the following condition is fulfilled:

optical distance from S5 to the wafer plane 4 > used diameter of S5.
Col. 5, ll. 44-50.

In other words, not only is the prior art problem of high layer tension on the fifth mirror recognized in the '470 patent, the patent describes techniques to prevent such surface deformations.

Based on these descriptions, the applicant submits that the subject matter of claim 61 is supported in the '470 patent and thus not anticipated by the '716 patent. The rejection based on the '716 patent is traversed and reconsideration respectfully requested.

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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